

How to Cite:

Parhi, A., & Routray, S. K. (2025). Balancing digital transformation and financial performance: An empirical study of IT investments in the education sector. *International Journal of Economic Perspectives*, 19(10), 120–135. Retrieved from <https://ijeponline.org/index.php/journal/article/view/1102>

Balancing digital transformation and financial sustainability: An empirical study of IT investments in the education sector

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Abstract--This study examines the impact of IT/software expenditure on financial performance within the education sector, where digital transformation is increasingly central to institutional sustainability. Utilizing panel data comprising 155 firm-year observations from academic institutions over the period 2020–2024, the analysis employs a multivariate regression framework estimated via Ordinary Least Squares (OLS) with Newey-West heteroskedasticity- and autocorrelation-consistent standard errors to address potential econometric concerns. The empirical results reveal a significant negative association between IT/software investment and financial outcome, indicating that technology investments may impose short-term financial pressures due to substantial upfront costs, implementation challenges, and delayed realization of efficiency gains. In addition, firm size and liquidity exert significant positive effects on performance, while leverage demonstrates a strong negative influence, underscoring the importance of firm-level financial characteristics in shaping institutional outcomes. The findings suggest that while IT/software adoption is critical for long-term competitiveness and academic innovation, its successful financial translation depends on strategic alignment, financial capacity, and robust governance. This research contributes to the expanding literature on IT investment and financial outcomes in higher education and offers practical implications for institutional leaders and policymakers in developing sustainable digital transformation strategies.

Keywords--IT/software investment, firm performance, education sector, multivariate regression, financial characteristics, Newey-West estimation.

Introduction

Education serves as a fundamental driver for socio-economic development, acting as a catalyst for individual growth, national productivity, and societal well-being (Hanushek & Woessmann, 2015). In the contemporary global knowledge economy, the education sector is undergoing significant transformation, characterized by a progressive shift from traditional pedagogical approaches to the strategic integration of digital technologies (UNESCO, 2020). This digital transition is primarily driven by the need to address diverse learner expectations, enhance academic outcomes, and improve institutional competitiveness within increasingly dynamic educational environments. The adoption of Information Technology (IT) and software solutions has emerged as a critical enabler in this transformation process. Educational institutions are increasingly investing in sophisticated IT infrastructures such as learning management systems, digital libraries, virtual classrooms, data analytics platforms, and administrative automation tools to augment instructional delivery, optimize institutional operations, and foster pedagogical innovation (Brynjolfsson & McAfee, 2014; Selwyn, 2016).

The integration of such technologies facilitates personalized learning experiences, improves accessibility, enhances student engagement, and contributes to superior academic achievement and learner satisfaction (Almarashdeh, 2016). Beyond pedagogical advancements, IT and software investments are also increasingly recognized for their potential to influence the managerial and financial performance of educational institutions. Strategic technology adoption may yield significant operational efficiencies, streamline administrative processes, enable informed decision-making, and optimize resource utilization, thereby contributing to improved institutional performance and long-term financial sustainability (Dedrick et al., 2003; Melville et al., 2004). Moreover, institutions that proactively invest in digital capabilities often experience enhanced academic reputation, attract high-caliber faculty, expand student enrollment, and strengthen their competitive positioning within the higher education sector (Arbaugh, 2000).

Despite these potential advantages, the financial implications of IT investments in the education sector remain complex and context-dependent. Unlike profit-maximizing industries, educational institutions often encounter delayed realization of returns due to prolonged implementation cycles, substantial adaptation costs, and the need for capacity building among faculty and administrative personnel (Brynjolfsson & Hitt, 1998; Melville et al., 2004). Furthermore, institutional heterogeneity, including variations in governance frameworks, financial resource endowments, organizational culture, and stakeholder expectations (Parhi & Subudhi, 2024), may differentially mediate the performance outcomes associated with IT adoption (Sabherwal & Chan, 2001). Importantly, the existing empirical literature presents inconclusive and often contradictory findings regarding the economic returns of IT investments in education, thereby highlighting a significant

gap in current knowledge (Dedrick et al., 2003; Melville et al., 2004). In particular, there is a paucity of context-specific, institution-level studies that systematically examine the financial and operational performance impacts of IT and software investments within educational settings, especially in emerging economies where resource constraints and institutional priorities may significantly shape investment outcomes.

Against this backdrop, the present study seeks to advance the literature by empirically investigating the relationship between IT and software investments and the performance of educational institutions. Specifically, the study addresses the central research question: Does investment in IT and software significantly influence the performance outcomes of educational institutions? Through this inquiry, the study aims to generate evidence-based insights that may inform institutional policymakers, administrators, and regulatory bodies in formulating effective IT investment strategies that support institutional competitiveness, operational excellence, and long-term value creation within the higher education sector.

Theoretical Background

Resource-Based View (RBV)

The Resource-Based View (RBV) posits that an organization's sustainable competitive edge stems from the possession of unique and strategically valuable resources that exhibit characteristics of being valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 1991; Wernerfelt, 1984). Within the context of academic institutions, investments in IT and software, such as enterprise resource planning (ERP) systems, learning management systems (LMS), digital libraries, data analytics platforms, and student information systems, constitute such strategic resources when effectively integrated into institutional operations (Bharadwaj, 2000; Melville et al., 2004). These digital resources enable institutions to automate administrative processes, enhance instructional delivery, personalize student learning experiences, optimize resource allocation, and strengthen decision-making capabilities (Brynjolfsson & McAfee, 2014; Selwyn, 2016). When properly leveraged, IT-enabled resources can elevate institutional performance by improving operational efficiency, reducing transaction costs, expanding academic reach, and enhancing service quality, which collectively translate into superior financial and non-financial outcomes such as improved return on assets (ROA), enhanced institutional reputation, and student satisfaction (Dedrick et al., 2003; Melville et al., 2004; Mohanty et al., 2024). However, while RBV emphasizes the possession of strategically valuable resources, it does not fully address how organizations must continually adapt and restructure these resources to maintain competitiveness in dynamic and uncertain environments. This conceptual limitation is addressed by extending the analysis through the lens of Dynamic Capabilities Theory.

Dynamic Capabilities Theory (DCT)

Dynamic Capabilities Theory (DCT) builds upon and extends the RBV by focusing on an organization's ability to continuously sense opportunities and threats, seize them effectively, and reconfigure internal and external competencies in response to

environmental changes (Teece, Pisano, & Shuen, 1997; Eisenhardt & Martin, 2000). In educational settings, IT and software investments rarely yield automatic performance improvements. Rather, institutions must develop the internal capacity to adapt these technologies to fit pedagogical, administrative, and regulatory contexts. This adaptive capability involves not only technological implementation but also organizational learning, process redesign, staff training, cultural transformation, and strategic alignment with institutional goals (Arbaugh, 2000; Sabherwal & Chan, 2001). For example, effective utilization of data analytics platforms requires that institutions cultivate analytical skills among administrative and academic staff, build robust data governance frameworks, and embed data-driven practices into decision-making processes (Teece, Peteraf, & Leih, 2016). Variation in the performance effects of IT/software investments across academic institutions can often be attributed to differences in their dynamic capabilities. Institutions that exhibit greater agility in reconfiguring processes, reallocating resources, and integrating new technologies are better positioned to capitalize on IT investments and navigate shifts in regulatory standards, technological advancements, and competitive pressures (Zahra & George, 2002).

Literature Review and Hypothesis Development

The relationship among information technology (IT), software investments, and enterprise performance has attracted sustained scholarly attention across multiple disciplines, including information systems, management, and organizational studies. Over the past several decades, extensive research has sought to determine whether investments in IT infrastructure, enterprise software, and digital technologies translate into superior financial and operational outcomes for enterprises (Brynjolfsson & Hitt, 1996; Bharadwaj, 2000; Melville et al., 2004). While a large body of empirical work reports positive associations between IT investments and firm performance, the findings remain mixed, with numerous studies highlighting contingent, delayed, or even negative effects depending on contextual and organizational factors. Early studies by Brynjolfsson and Hitt (1996, 1998) introduced the "productivity paradox," wherein substantial IT expenditures were not immediately reflected in firm productivity or profitability. This paradox was attributed to the time required for organizational learning, adaptation, and process reengineering, suggesting that performance benefits may only materialize once firms develop the complementary capabilities necessary to leverage IT investments effectively. Over time, as organizations accumulate technological experience and embed IT resources into core operations, positive financial outcomes tend to emerge (Brynjolfsson & Hitt, 1998). Building on these early insights, Bharadwaj (2000) extended the analysis by applying the Resource-Based View (RBV), proposing that IT capabilities can function as strategic organizational assets when they are valuable, rare, inimitable, and non-substitutable. According to RBV logic, firms that develop unique IT competencies, such as customized software integration, data analytics capabilities, and proprietary digital platforms, may achieve sustained competitive advantages that contribute to superior financial performance. More recent empirical studies have further reinforced the performance-enhancing role of IT and software investments, while simultaneously acknowledging their contingent nature. Pedersen et al. (2022), for instance, documented that software-centric investments significantly improve operational efficiency and firm value, particularly when strategically aligned with organizational

processes. Similarly, Alfalah et al. (2022), focusing on the telecommunications sector, demonstrated that IT investments yield higher profitability and operational improvements when supported by robust governance mechanisms and corporate social responsibility frameworks, underscoring the managerial and ethical dimensions influencing IT returns.

The growing adoption of advanced digital technologies, including artificial intelligence (AI), big data analytics, cloud computing, and the Internet of Things (IoT), has further expanded the discourse on IT's influence on enterprise performance. Studies by Agrawal et al. (2019) and Barro and Davenport (2019) emphasize that AI-driven systems enhance decision-making efficiency, reduce operational costs, and improve profitability. Similarly, Sun and Jiao (2024) found that IT and software investments positively affect financial indicators such as return on equity (ROE) and Tobin's Q, particularly when firms demonstrate strong digital readiness. Zhang and Wang (2024) added that successful digital transformation efforts—heavily reliant on IT and software investments, serve as critical drivers of long-term firm value creation. Despite substantial evidence supporting the positive association among IT/software investments and enterprise outcome, a notable stream of literature presents more nuanced or even contradictory findings. Several studies highlight the existence of significant time lags before IT investments yield measurable financial benefits, particularly during early implementation phases characterized by technical disruptions, employee training costs, and organizational adjustments (Lee et al., 2016; Melville et al., 2004). For example, a panel study by Jardak and Ben Hamad (2022) in Scandinavian markets reported that while digital maturity positively affected market valuation, it initially exerted downward pressure on short-term accounting measures such as return on assets (ROA) and return on equity (ROE). These mixed results suggest that the financial impacts of IT investments may not be immediate and that short-term declines may precede long-term gains. Collectively, the mixed findings in extant literature underscore several important research gaps that warrant further empirical investigation. First, while numerous studies examine IT investment effects in corporate sectors such as manufacturing, financial services, and telecommunications, there remains limited empirical evidence regarding academic institutions, particularly in developing economies. Academic institutions operate under distinct organizational logics, resource constraints, and governance structures that may significantly influence the performance outcomes of IT and software investments (Dedrick et al., 2003). Thus, sector-specific inquiry within the higher education domain remains underexplored.

Second, prior studies often aggregate IT expenditures into composite metrics that conflate hardware, infrastructure, and software investments. However, software investments encompassing enterprise resource planning (ERP), learning management systems (LMS), student information systems (SIS), and data analytics platforms may play a more strategic role in influencing educational service delivery, administrative efficiency, and financial management. Disaggregating IT investments and isolating the financial impact of software expenditures offers a more focused examination of their contribution to institutional performance. Third, most prior research is based on cross-sectional or short-time-frame analyses, which may fail to capture the dynamic nature of IT investment outcomes. Longitudinal panel data allows for a more comprehensive assessment of both

immediate and delayed performance effects, thereby offering deeper insights into the temporal dimension of IT value realization (Melville et al., 2004). Finally, given the increasing digitalization of higher education, exacerbated by global disruptions such as the COVID-19 pandemic, academic institutions are increasingly reliant on digital platforms, online learning technologies, and administrative software solutions to ensure pedagogical continuity, operational resilience, and financial sustainability (UNESCO, 2020). In this evolving context, understanding the financial implications of software investments becomes highly relevant for institutional leaders, policymakers, and stakeholders seeking to optimize IT resource allocation. Accordingly, the study advances the following hypothesis:

H1: There is a significant relationship between IT/software investment and financial performance (ROA) in academic institutions.

Research Design

This study employs a quantitative research design to empirically investigate the relationship between IT/software investments and financial performance within the education sector. Specifically, the study examines whether investments in IT/software contribute to improved institutional financial outcomes, measured by Return on Assets (ROA), while accounting for the distinctive operational and financial characteristics of academic institutions.

Data Source and Sampling

The empirical analysis is based on secondary data extracted from the CMIE Prowess IQ database, which provides comprehensive firm-level financial and operational information for Indian companies. The initial sampling frame consisted of 758 organizations classified under the education sector for the period 2020–2024. To ensure data consistency and reliability, only those institutions that reported IT/software investment data continuously across the full five-year period were retained. Firms with incomplete or missing data for two or more consecutive years were excluded to minimize potential estimation biases associated with unbalanced panel structures and data gaps. Following this rigorous screening process, the final sample comprises 31 academic institutions, yielding a balanced panel dataset covering five consecutive years. The panel structure enables the analysis to capture both cross-sectional firm-level heterogeneity and temporal dynamics, thereby accommodating potential time-lagged effects that are particularly relevant in the context of IT/software investment outcomes.

It is important to note that the sampled entities represent private education service providers and EdTech enterprises rather than conventional universities or publicly funded higher education institutions. These firms operate within the commercial education ecosystem comprising coaching, training, and technology-enabled learning services; where financial performance is driven by operational efficiency, market scalability, and technological integration. This distinction ensures that the dataset reflects organizations functioning under business-oriented governance models, thereby aligning the analysis with the broader strategic and financial behavior of the education services industry.

Sectoral Context and Justification

Education service and EdTech is a sector that is at the intersection of delivery of learning and commercial enterprise, with organizational logics that are not similar to traditional higher learning institutions or the pure technology companies. In contrast to universities or state education authorities, which focus their efforts on academic and social goals, in both private education and EdTech businesses have market-focused and performance-based designs, in which the implementation of IT and software systems is directed towards pedagogical improvement and business productivity (Brynjolfsson and Hitt, 1998; Dedrick et al, 2003). The IT spending in this industry tends to focus on such areas as creation of digital content, learning platforms based on adaptive learning, student management systems, and online course delivery, a set of initiatives that are supposed to simultaneously enhance learning results and be operationally scalable.

Nonetheless, the twofold mission of educational service providers, i.e., the combination of educational value with commercial sustainability, presents a peculiar strategic and financial flow. Enrollment volumes, subscription rates and brand differentiation affect the model of revenue as opposed to government grants or fixed tuition models (Melville et al., 2004). This commercial exposure exposes it to increased vulnerability to market cycles, technological discontinuity and consumer demands necessitating constant reinvestment of innovation and IT infrastructure. Concurrently, the payoffs of IT/software investments might be indirect or time-lagoo because learning outcomes or student satisfaction and reputation gains come first before quantifiable financial performance benefits (Sabherwal and Chan, 2001; Teece et al., 1997).

Moreover, these companies have difficulty related to sustaining the quality of instructions on a large-scale level, accommodating old systems with new digital designs, retraining of personnel and engaging learners on different platforms (Arbaugh, 2000; Almarashdeh, 2016). This complexity is why the education services and EdTech industry is a very interesting area of empirical research - an industry that integrates service innovation, technology intensity, and financial performance in a fast-paced knowledge economy. Through the analysis of IT/software investments by these companies, the paper would add to the knowledge on how technology-based strategic competencies serve to increase competitiveness and performance of education-based enterprises that follow hybrid academic-commercial frameworks.

Methodological Contribution

By focusing on academic institutions and employing panel data over a multi-year horizon, this study offers a more nuanced analysis that captures both immediate and delayed performance effects of IT/software investments. The sector-specific design responds to existing gaps in the literature, which has historically concentrated on commercial sectors and aggregated IT investments, often overlooking the distinct characteristics of software expenditures in educational settings (Pedersen et al., 2022; Alfalah et al., 2022).

Variables

Response Variable

Return on Assets (ROA) is employed as the predicted variable, serving as the primary indicator of financial performance. ROA effectively captures the institution's efficiency in deploying its total asset base to generate net earnings. Within the context of academic institutions, this measure reflects the organization's capacity to convert financial, physical, and human capital resources into financial surpluses that contribute to long-term operational sustainability and institutional development. ROA is computed by dividing net profit by total assets.

Explanatory Variables

The key independent variable is IT/Software Investment (ITSoftware), which represents the total annual expenditure allocated by academic institutions toward IT and software-related resources. This includes spending on administrative software, learning management systems, digital platforms, enterprise resource planning systems, data analytics solutions, and other IT-related services, as reported in institutional financial statements. IT/Software Investment is measured as total IT and software expenditures reported annually in ₹ Crore or ₹ Million.

Control Variables

To account for firm-specific heterogeneity and reduce possible bias due to unobserved variables, several control variables are integrated following established empirical literature. First, Enterprise Size (Enterprise Size) is included to capture potential advantages associated with institutional scale, such as economies of scale, broader access to financial and physical resources, and diversified academic operations that may impact financial outcomes. Enterprise size is calculated as the natural log of total assets. Second, the Liquidity Ratio (Liquidity) is incorporated to reflect the institution's liquidity position and capacity to fulfill short-term liabilities. Institutions with stronger liquidity positions may demonstrate greater operational resilience and capacity to support ongoing investment in IT infrastructure. Liquidity is calculated as current assets divided by current liabilities. Third, the model includes the Leverage Ratio (Leverage), which accounts for the proportion of debt financing employed in the institution's capital structure. Higher leverage levels may expose institutions to increased financial obligations, thus affecting profitability and elevating financial risk. Leverage is measured as total long-term debt divided by total assets. Finally, Operating Profitability (Operating) is introduced to capture the institution's core operational efficiency in generating income from its primary academic and administrative activities, independent of its financial structure. Higher operating profitability signals stronger internal performance and greater capacity to absorb investment costs. Operating profitability is calculated as operating profit divided by total sales (refer table 1).

Table 1: Indicators' Description

SN	Indicator Name	Operational Definition	Notation
Predicted Variable			
1	Return on Assets	Ratio of net profit to total assets	ROA
Independent Variables			
2	IT/Software Investment	Total IT & Software Expenses (₹ Crore / ₹ Million)	ITSoftware
Control Variables			
3	Enterprise Size	Natural log of total assets	SIZE
4	Liquidity Ratio	Liquidity = Current Assets / Current Liabilities	Liquidity
5	Leverage	The ratio of long-term debt to total assets	LEV
6	Operating Profitability	Operating Profit (PBIT)	Operating

Source: Authors' Compilation

Model Specification

The following linear regression model was estimated to study the effect of IT/software investment and firm-specific factors on firm performance (ROA) in the education sector:

$$ROA_{it} = \beta_0 + \beta_1 ITSoftware_{it} + \beta_2 EnterpriseSize_{it} + \beta_3 Liquidity_{it} + \beta_4 Leverage_{it} + \beta_5 Operating_{it} + \epsilon_{it}$$

Where, ROA_{it} represents the Return on Assets for firm i at time t , which serves as the dependent variable capturing firm performance. $ITSoftware_{it}$ denotes the IT/software investment made by firm i at time t , reflecting the extent of technological adoption within the institution. $EnterpriseSize_{it}$ refers to the size of firm i at time t , measured as the natural logarithm of total assets, indicating the scale of operations and resource base of the institution. $Liquidity_{it}$ is calculated as the ratio of current assets to current liabilities for firm i at time t , representing the firm's short-term financial health and ability to meet immediate obligations. $Leverage_{it}$ indicates the financial leverage of firm i at time t , computed as total debt divided by total assets, which reflects the degree of debt financing relative to total resources. $Operating_{it}$ represents the operating profit ratio for firm i at time t , capturing the operational efficiency of the firm in generating profit from its core activities. $\beta_1, \beta_2, \beta_3, \beta_4,$ and β_5 represent the estimated coefficients corresponding to the predictor and control variables in the regression model. Finally, ϵ_{it} is the stochastic residual that accounts for non-observable factors and random disturbances affecting the dependent variable.

Empirical Results

Summary Statistics

Table 2 presents the univariate statistics for all variables employed in the empirical investigation, conducted using a balanced panel of 155 firm-year records drawn from academic institutions over the study period. The predicted variable, Return on Assets (ROA), exhibits a mean value of -0.1679 with a standard deviation of 0.5740. This suggests that, on average, the sampled institutions experienced

marginally negative financial performance during the observation window, with substantial variability across firms. The observed ROA ranges from a minimum of -3.4663 to a maximum of 0.3933, indicating the presence of considerable heterogeneity in financial outcomes, where some institutions have reported significant losses while others achieved moderate profitability.

The primary independent variable, IT/Software Investment (ITSoftware), demonstrates a mean of 1.4102 and a standard deviation of 2.0541, reflecting notable dispersion in IT/software expenditure across institutions. The values range from -2.3026 to 6.0285, indicating that while some institutions have undertaken substantial IT/software investments, others report relatively lower or even negative adjustments, which may reflect capital write-offs, asset reclassifications, or reductions in IT capital stock. The control variable Enterprise Size (Enterprise Size), calculated as the natural log of total assets, has a mean value of 7.0050 with a standard deviation of 1.9943. The range of Enterprise Size varies from 2.4849 to 10.8974, highlighting significant variation in institutional scale within the sample, encompassing both smaller academic institutions and substantially larger educational organizations. The Liquidity Ratio (Liquidity) presents a mean of 2.6533 and a standard deviation of 3.8827, with values ranging between 0.0283 and 29.0000. The wide dispersion indicates substantial differences in short-term financial flexibility, suggesting that while certain institutions maintain substantial liquidity reserves, others operate with relatively constrained current assets relative to their short-term liabilities. The Leverage Ratio (Leverage) has a mean value of 0.3516 and a standard deviation of 1.2233, with observed values ranging from 0.0008 to 12.0983. This considerable variation reflects heterogeneity in capital structure strategies across institutions, with some adopting relatively conservative debt positions while others rely more extensively on debt financing to support their operations. Finally, Operating Profitability (Operating) displays a mean of 380.3942 with a standard deviation of 1190.062, and ranges from -896.7000 to 11583.3000. The magnitude of dispersion highlights substantial cross-institutional differences in operational efficiency and revenue-generating capacity, with certain institutions demonstrating significant positive operating performance while others report operational deficits.

Table 2: Univariate Summary Outcomes

Indicator	Obs	Mean	Sd. Dv.	Min	Max
ROA	155	-.1678613	.5739584	-3.466307	.3933206
ITSoftware	155	1.41017	2.054138	-2.302585	6.028519
Enterprise Size	155	7.00501	1.994305	2.484907	10.89738
Liquidity	155	2.653343	3.882689	.0280304	29
Leverage	155	.3516464	1.223278	.0007513	12.09832
Operating	155	380.3942	1190.062	-896.7	11583.3

Source: Authors' Computation

STATA 14 Univariate Summary; 2025

Correlation Matrix and VIF

Table 3 presents the pairwise correlation coefficients and Variance Inflation Factor (VIF) statistics for all predictors. Return on Assets (ROA) posits positive association with Enterprise Size (0.3931), Liquidity (0.2317), and Operating Profitability (0.2786), while displaying a strong negative association with Leverage (-0.7516), indicating that institutional size, liquidity, and operational efficiency are positively associated with financial performance, whereas higher debt levels are linked to weaker performance outcomes. The correlation between ROA and IT/Software Investment is negative but marginal (-0.1102), suggesting a weak bivariate relationship between IT expenditures and profitability. IT/Software Investment establishes a moderate positive correlation with Enterprise Size (0.5696), reflecting that larger institutions have a tendency to allocate greater resources toward IT/software. The VIF with a mean of 1.52, well below the conventional multicollinearity threshold, signifying that multicollinearity is unlikely to bias the regression outcomes.

Table 3: Correlation Table and VIF

Indicator	ROA	ITSoftware	Enterprise Size	Liquidity	Leverage	Operating	VIF
ROA	1						
ITSoftware	-0.1102	1					1.98
Enterprise Size	0.3931	0.5696	1				1.93
Liquidity	0.2317	-0.3944	-0.1835	1			1.30
Leverage	-0.7516	0.1941	-0.1987	-0.1411	1		1.22
Operating	0.2786	0.3079	0.4750	-0.0775	-0.0963	1	1.19
Mean Value VIF							1.52

Source: Authors' Computation
STATA 14 Correlation Table and VIF; 2025

Ordinary Least Squares with Newey-West standard errors

To address potential issues of heteroskedasticity and autocorrelation within the panel dataset, the multivariate regression model was estimated using Ordinary Least Squares (OLS) with Newey-West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors. This estimation technique allows for robust inference even in the presence of time-series dependence or heteroskedastic disturbances, ensuring valid hypothesis testing despite potential violations of classical OLS assumptions. The regression results reveal that IT/Software Investment exerts a statistically significant negative effect on financial performance, as measured by Return on Assets (ROA), with a coefficient of -0.0425 ($p = 0.010$). This result suggests that excessive IT/software expenditures may impose short-term financial pressures on academic institutions, potentially reflecting substantial upfront capital outlays, learning curve inefficiencies, and delayed productivity gains associated with technology assimilation. Consistent with expectations, Enterprise Size exhibits a positive and highly significant association with ROA (coefficient = 0.0937, $p < 0.001$), indicating that larger institutions benefit from scale economies,

broader resource access, and operational diversification, which collectively enhance financial performance. Liquidity, proxied by the current ratio, is also positively and significantly related to ROA (coefficient = 0.0226, $p = 0.004$), suggesting that institutions with stronger short-term financial positions are better equipped to manage ongoing operational obligations and sustain profitability. In contrast, Leverage establishes a strong negative and highly significant relationship with ROA (coefficient = -0.2928, $p < 0.001$), highlighting the detrimental impact of elevated debt financing on institutional financial health, likely due to increased financial risk and interest payment obligations. The coefficient for Operating Profitability is positive (0.0000591), though it does not reach conventional significance levels ($p = 0.093$), implying a limited marginal effect on overall financial performance once other covariates are accounted for. The overall model remains statistically significant (Prob > F = 0.000), indicating that the set of explanatory variables collectively explains a significant proportion of the variation in financial performance and that the estimated relationships are robust after correcting for potential econometric concerns.

Table 4: Regression with Newey-West standard errors

Independent Variable	Dependent Variable: Return on Assets	
	Coefficient Values	Standard Error
ITSoftware	-.0424509*** (0.01)	.0162373
Enterprise Size	.0936681*** (0.00)	.0176865
Liquidity	.0226109*** (0.00)	.0078177
Leverage	-.2928019*** (0.00)	.0591663
Operating	.0000591*** (0.09)	.0000349
-Cons	-.7436694*** (0.00)	.1393866
Observations	155	
R Square	0.6833	

Source: Authors' Computation, STATA 14 Regression with Newey-West standard errors; 2025

Note: Parentheses enclose p-values. Asterisks *, **, and *** correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Multivariate Regression Results

Table 5 presents the multivariate regression estimates examining the relationship among IT/software expenditure and Enterprise performance, as measured by ROA. The model incorporates IT/Software Investment (ITSoftware), Firm Size (FirmSize), Liquidity, Leverage, and Operating Profitability as explanatory variables. The results indicate that IT/Software Investment is negatively and significantly associated with ROA, with a coefficient of -0.0425 ($p = 0.010$). This finding suggests that higher IT/software expenditures are associated with short-term reductions in financial performance, potentially reflecting the initial cost burden, adjustment inefficiencies, or delayed realization of productivity gains following technology adoption within academic institutions. Firm Size exhibits a positive and highly significant effect on ROA (coefficient = 0.0937, $p < 0.001$), indicating that larger institutions benefit from economies of scale, superior resource allocation, and broader operational capacity, all of which contribute to enhanced financial outcomes. Similarly, Liquidity shows a positive and statistically significant

relationship with ROA (coefficient = 0.0226, $p < 0.001$), implying that institutions with stronger short-term financial flexibility are better positioned to meet operational obligations and maintain profitability. In contrast, Leverage exhibits a strong negative and highly significant association with ROA (coefficient = -0.2928, $p < 0.001$), highlighting the adverse impact of higher debt exposure on institutional financial performance, likely driven by increased financial risk and interest obligations. Operating Profitability is positively associated with ROA (coefficient = 0.0000591, $p = 0.020$), though its incremental contribution appears modest after controlling for other financial and operational factors. The model explains approximately 68.33% of the variation in ROA ($R^2 = 0.6833$), indicating substantial explanatory power. Overall, the regression results provide robust evidence that, while IT/software investments may exert short-term financial pressures on academic institutions, firm size, liquidity, and prudent leverage management play significant roles in sustaining positive financial performance.

Table 5: Multivariate Regression Results

Independent Variable	Dependent Variable: Return on Assets	
	Coefficient Values	Standard Error
ITSoftware	-.0424509 (0.01)	.0179157
Enterprise Size	.0936681 (0.00)	.0186649
Liquidity	.0226109 (0.00)	.0074422
Leverage	-.2928019 (0.00)	.0239178
Operating	.0000591 (0.02)	.0000253
-Cons	-.7436694 (0.00)	.123773
Observations	155	
R Square	0.6833	

Source: Authors' Computation, STATA 14 Multivariate Regression; 2025

Note: Parentheses enclose p-values. Asterisks *, **, and *** correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Discussion

The empirical findings provide important insights into how IT/software investments affect financial performance in the higher education sector, while highlighting the role of firm-specific financial characteristics. After controlling for heteroskedasticity and autocorrelation, the regression analysis shows a significant negative association among IT/software investment and Return on Assets (ROA). This suggests that higher IT/software expenditures may initially reduce profitability, reflecting substantial upfront costs, prolonged implementation periods, and institutional adaptation challenges. Unlike commercial sectors, educational institutions typically experience delayed or indirect financial benefits, as full technology integration often requires extended adjustment periods while financial obligations are incurred immediately. These short-term adverse effects may also result from capital misallocation, limited technical expertise, weak IT governance, and fragmented managerial oversight, which constrain productivity gains (Weill & Aral, 2006; van de Wetering et al., 2021). In resource-constrained settings, external pressures may further drive premature IT adoption without sufficient long-term planning, resulting in higher financial strain. Moreover, many IT investments in

education primarily enhance non-financial outcomes, such as academic quality, student satisfaction, and institutional reputation, which may not be immediately reflected in financial metrics but contribute to long-term institutional value. The analysis also underscores the significance of financial characteristics in determining institutional performance. Firm size positively influences ROA, reflecting scale advantages and resource diversification, while liquidity supports financial flexibility in managing operational obligations. In contrast, leverage is negatively associated with performance, emphasizing the financial risks linked to higher debt burdens in education. Operating profitability contributes positively but remains marginal after controlling for broader financial structures. Collectively, these findings contribute to both conceptual and practical understanding. From a conceptual perspective, the findings align with the Resource-Based View and Dynamic Capabilities Theory, underscoring that IT/software investments alone are insufficient without effective institutional capabilities for integration and adaptation. From a managerial standpoint, institutional leaders must adopt phased and strategically aligned IT investment approaches, supported by robust governance, capacity building, and financial sustainability measures. Policymakers and accreditation agencies should facilitate institutional readiness by strengthening IT governance, financial planning, and staff development. Given the potential for long-term performance gains, future research may explore extended time horizons as institutions gradually realize the financial and non-financial benefits of IT/software integration.

Conclusion

This study examines the relationship among IT/software expenditure and financial outcome in the higher education sector, utilizing a multivariate regression framework on panel data comprising 155 firm-year observations. To address econometric concerns, the analysis employs Ordinary Least Squares (OLS) estimation with Newey-West heteroskedasticity- and autocorrelation-consistent standard errors, ensuring robust inference. The result reveals a statistically significant negative association among IT/software investment and Return on Assets (ROA), suggesting that while IT adoption is strategically essential for academic innovation, it may impose short-term financial burdens due to upfront costs, transitional inefficiencies, and operational adjustments during early implementation phases. These results underscore the need for institutions to align IT investments with long-term strategies, resource capacity, and effective change management to fully realize financial and operational benefits. Beyond IT investment, several firm-level financial characteristics significantly affect performance. Firm size positively influences ROA, reflecting benefits from economies of scale and resource diversification. Liquidity also contributes positively, highlighting the importance of financial flexibility. Conversely, leverage exerts a strong negative impact, reflecting heightened financial risks from debt exposure in a revenue-sensitive sector. While operating profitability has a positive effect, its marginal significance suggests that financial structure and strategic management remain dominant drivers of performance. Future research may explore non-financial outcomes of IT investments, such as student satisfaction, academic quality, and institutional reputation. Applying advanced econometric techniques to address endogeneity, extending longitudinal analyses to capture delayed effects, and conducting cross-country comparative studies may offer

further insights into how institutional and regulatory environments shape IT investment outcomes in higher education.

Acknowledgement

The authors would like to express their sincere gratitude to the Centurion University of Technology and Management, Odisha, for providing access to research facilities and data resources essential for this study. The authors are also thankful to the CMIE Prowess IQ database team for their comprehensive data support. Special appreciation is extended to colleagues and reviewers for their valuable feedback and guidance throughout the research process.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. All authors have contributed equally and have no financial, personal, or professional affiliations that could be perceived to influence the findings or interpretation of this research.

References

- Agrawal, A., Gans, J. S., & Goldfarb, A. (2019). Exploring the impact of artificial intelligence: Prediction versus judgment. *Information Economics and Policy*, 47, 1-6.
- Alfalah, A. A., Muneer, S., & Hussain, M. (2022). An empirical investigation of firm performance through corporate governance and information technology investment with mediating role of corporate social responsibility: Evidence from Saudi Arabia telecommunication sector. *Frontiers in Psychology*, 13, 959406.
- Almarashdeh, I. (2016). Sharing instructors experience of learning management system: A technology perspective of user satisfaction in distance learning course. *Computers in Human Behavior*, 63, 249-255.
- Arbaugh, J. B. (2000). Virtual classroom characteristics and student satisfaction with internet-based MBA courses. *Journal of management education*, 24(1), 32-54.
- Barro, S., & Davenport, T. H. (2019). People and machines: Partners in innovation. *MIT Sloan Management Review*, 60(4), 22-28.
- Bharadwaj, A. S. (2000). A resource-based perspective on information technology capability and firm performance: an empirical investigation. *MIS quarterly*, 169-196.
- Brynjolfsson, E., & Hitt, L. (1996). Paradox lost? Firm-level evidence on the returns to information systems spending. *Management science*, 42(4), 541-558.
- Brynjolfsson, E., & Hitt, L. M. (1998). Beyond the productivity paradox. *Communications of the ACM*, 41(8), 49-55.
- Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. WW Norton & company.
- Dedrick, J., Gurbaxani, V., & Kraemer, K. L. (2003). Information technology and economic performance: A critical review of the empirical evidence. *ACM Computing Surveys (CSUR)*, 35(1), 1-28.

- Hanushek, E. A., & Woessmann, L. (2015). The economic impact of educational quality. In *Handbook of international development and education* (pp. 6-19). Edward Elgar Publishing.
- Jardak, M. K., & Ben Hamad, S. (2022). The effect of digital transformation on firm performance: evidence from Swedish listed companies. *The Journal of Risk Finance*, 23(4), 329-348.
- Lee, H., Choi, H., Lee, J., Min, J., & Lee, H. (2016). Impact of IT investment on firm performance based on technology IT architecture. *Procedia Computer Science*, 91, 652-661.
- Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Information technology and organizational performance: An integrative model of IT business value. *MIS quarterly*, 283-322.
- Mohanty, K. R., Parhi, A., & Subudhi, R. N. (2024). The multifaceted world of integrated reporting: A journey-through theory. *Multidisciplinary Reviews*, 7(12), 2024280-2024280.
- Parhi, A., & Subudhi, R. (2024). Redefining Corporate Accountability: Impact of Shareholder Composition on CSR Expenditure in Indian Firms. *Innovative Synergies*, 9781003650041-6.
- Pedersen, T., Scedrova, A., & Grecu, A. (2022). The effects of IT investments and skilled labor on firms' value added. *Technovation*, 116, 102479.
- Selwyn, N. (2016). *Is technology good for education?*. John Wiley & Sons.
- Sun, J., & Jiao, H. (2024). Emerging IT investments and firm performance: a perspective of the digital options. *Chinese Management Studies*, 18(2), 506-525.
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, 18(7), 509-533.
- Unesco. (2020). *Education in a post-COVID world: Nine ideas for public action*. International Commission on the Futures of Education.
- Van De Wetering, J., Leijten, P., Spitzer, J., & Thomaes, S. (2022). Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis. *Journal of Environmental Psychology*, 81, 101782.
- Weill, P., & Aral, S. (2006). *Generating premium returns on your IT investments*. MIT Sloan Management Review.
- Zhang, P., & Wang, Y. (2024). Digital transformation: A systematic review and bibliometric analysis from the corporate finance perspective. arXiv preprint arXiv:2412.19817.